ISSN 0097-4463

ANNALS
of CARNEGIE MUSEUM

CARNEGIE MUSEUM OF NATURAL HISTORY

4400 FORBES AVENUE • PITTSBURGH, PENNSYLVANIA 15213

VOLUME 50 8 JULY 1981 ARTICLE 10

NEW OLIGOCENE RODENTS FROM WESTERN NORTH AMERICA

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ABSTRACT

A new scuirid, ?*Protosciurus douglassi*, from the Orellan of Nebraska is described. ?*P. douglassi* is viewed as a member of an early lineage of sciurids, represented by ?*P. jeffersoni* (Douglass) from the Chadronian of Montana. This lineage is viewed as distinct from that represented by *Protosciurus mengi* Black also from the Orellan of Nebraska.

An anomalous dentition of the Whitneyan cricetid *Eumys brachyodus* Wood is described and possible homologies are suggested.

Three new species of the cricetid *Scottimus*—*S. viduus*, *S. ambiguus*, and *S. longiquus*—are named. The occurrence of all of these species in the Orellan show the marked diversity and regional speciation of this genus at that time. The skull of *Scottimus* shares many features with that of *Leidymys* Wood, suggesting a close relationship between these taxa. The genus *Eoeumys* Martin is not congeneric with "*Eumys*" *exiguus* because of marked differences in the skull and dentition. *Eoeumys* is referred to the Eumyinae rather than Eucricetodontinae.

A generically indeterminate cricetid is described from the Orellan of North Dakota. This specimen most closely resembles two late Oligocene cricetids from central Asia, *Aralomys* Argyropulo and *Eumysodon* Argyropulo.

INTRODUCTION

The first review of North American Oligocene rodents was included in Cope's (1884) survey of all of the Tertiary vertebrates of the western United States. He recognized 18 species from the "White River" beds. The next review of Oligocene rodents of North America was over 50 years later by Wood (1937). Wood presented a review of all of the previous literature on the White River rodents and introduced many

Submitted 17 December 1980.

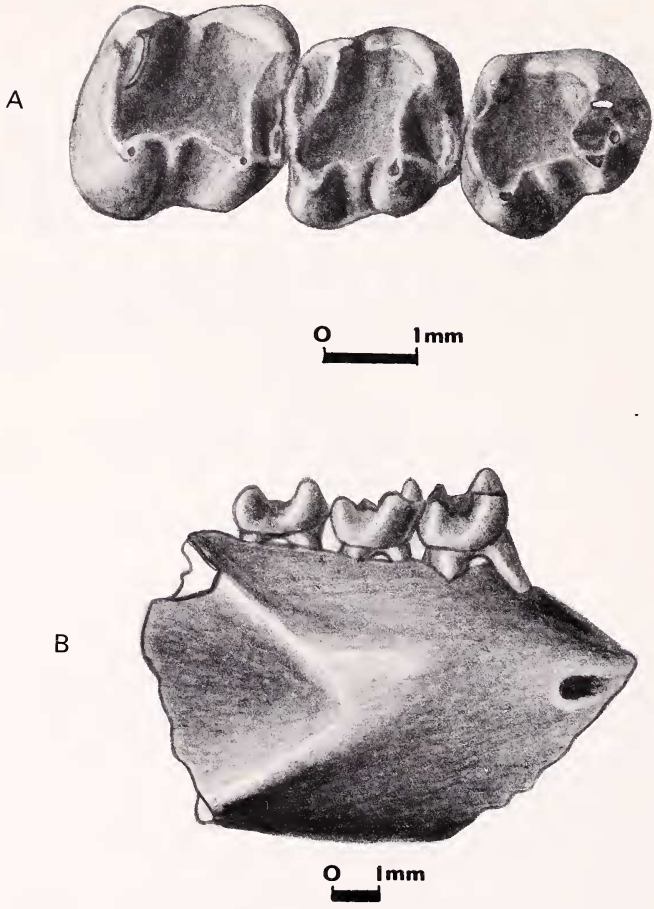

Fig. 1.—?*Protosciurus douglassi*, new species, holotype CM 38654. A, occlusal view of P_4–M_2; B, lateral view of mandible.

new genera and species. Since Wood's (1937) review, numerous new species and genera of Oligocene rodents have been described, generally as part of a faunal description of a specific locality (for example, Wilson, 1949*a*; Black, 1965; Russell, 1972; Wood, 1974).

Recently, Wood (1980) presented a summary of all previously described Oligocene rodents, in which he recognized over 80 species of rodents. Since Wood's summary, Martin (1980) has introduced 3 additional genera of Orellan rodents.

A study of unpublished specimens of Oligocene rodents in the collections of Carnegie Museum of Natural History and previously de-

Table 1.—*Measurements of the teeth of the holotype of* ?Protosciurus douglassi, *CM 38659. Measurements in millimeters.*

Teeth	A-P	tra	trp
P_4	1.91	1.54	1.93
M_1	1.87	1.95	2.05
M_2	2.24	2.23	2.30
I_1	2.87	1.3[illegible]	

scribed material from other museums has yielded one new species or sciurid and three new species of cricetids from the Orellan. This new material increases the diversity of both sciurids and cricetids known from the Oligocene of North America.

Abbreviations.—AMNH, American Museum of Natural History; CM, Carneige Museum of Natural History; KU, University of Kansas Museum of Natural History; MCZ, Museum of Comparative Zoology, Harvard University; PU, Princeton University; UNSM, University of Nebraska State Museum; USNM, National Museum of Natural History, Smithsonian; A-P, anteroposterior length; tra, anterior transverse width; trp, posterior transverse width; N, number of specimens measured; M, mean; SD, standard deviation; OR, observed size range; CV, coefficient of variation. Dental terminology after Wood and Wilson (1936).

SYSTEMATIC PALEONTOLOGY

Order Rodentia Bowdich, 1821
Family Sciuridae Gray, 1821
?*Protosciurus douglassi,* new species
(Fig. 1, Table 1)

Holotype.—CM 38659, right mandible with P_4–M_2.

Horizon and locality.—Orella Member, Brule Formation, Prairie Dog Creek, SE¼, T33N, R56W and W½, T33N, R55W, Sioux County, Nebraska.

Age.—Orellan (early middle Oligocene).

Hypodigm.—Holotype only.

Entymology.—Named in honor of Earl Douglass for his many contributions to vertebrate paleontology.

Diagnosis.—Small species; trigonid basins on lower cheek teeth relatively large and enclosed; entoconid separated from posterolophid by shallow groove; mesostylids distinct; partial hypolophid runs from entoconid to center of posterolophid; mesoconid and ectolophid poorly developed.

Description.—The masseteric fossa on the mandible terminates anteriorly below M_1 (Fig. 1b). A lateral swelling is present just anterior to the masseteric fossa. The mental foramen is located low on the side of the mandible below the posterior end of the diastema.

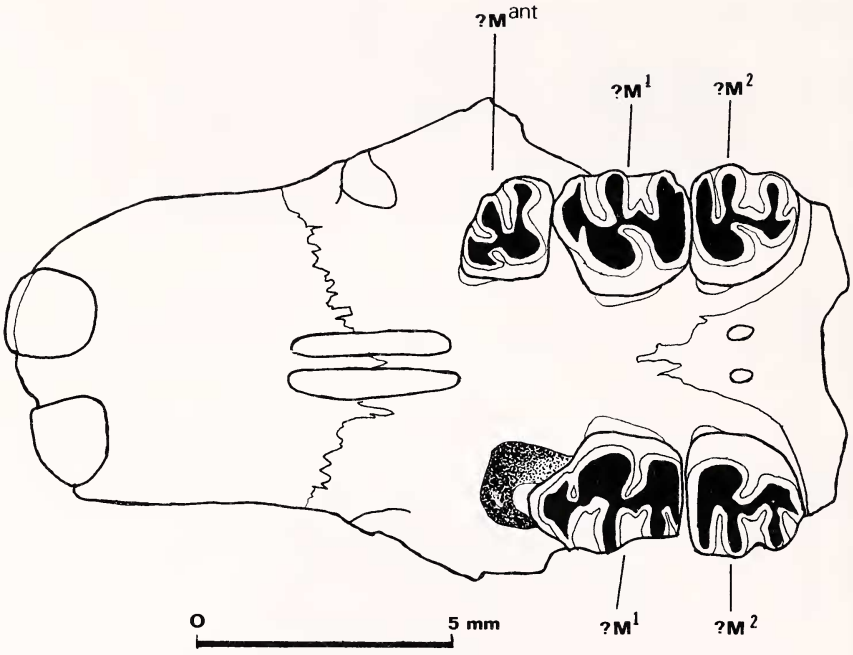

Fig. 2.—*Eumys brachyodus*. USNM 66028, ventral view of the skull.

The lower incisor is laterally compressed, flattened medially, and rounded laterally.

The trigonid basins of P_4–M_2 are enclosed and relatively large, decreasing in relative size and increasing in anteroposterior compression from P_4 to M_2. M_1 and M_2 are wider than long (Table 1). A distinct hypolophid runs from the entoconid into the talonid basin, then turns posteriorly and joins the posterolophid just lingual to its center on P_4–M_2.

The mesoconid is minute and the ectolophid is weak on P_4–M_2. A distinct mesostylid is present on all of the lower cheek teeth. The entoconid is separated from the posterolophid by a shallow groove, and from the mesostylid by a deeper groove. M_2 is the largest tooth preserved.

Discussion.—?*Protosciurus douglassi* most closely resembles ?*P. jeffersoni* from the early Oligocene of Pipestone Springs, Montana (Douglass, 1901; Black, 1965). It differs from all other species of *Protosciurus,* as does ?*P. jeffersoni,* in the possession of a hypolophid which extends into the talonid basin from the entoconid. Because of this structure, Black (1965) questionably referred the Pipestone Springs species to *Protosciruus.* ?*P. douglassi* is clearly referable to the same genus as ?*P. jeffersoni.* Whether these species truly represent *Protosciurus* is still questionable. Black (1965) has shown that ?*P. jeffersoni,* thus ?*P. douglassi,* is clearly not referable to the aplodontid *Cedromus* Wilson (1949*a*) as was suggested by Wood (1962, 1980).

?*P. douglassi* differs from ?*P. jeffersoni* in being 30% smaller, having cusps less bulbous and more marginally placed, having the hypolophid join the posterolophid, and having the mesoconid and ectolophid less pronounced.

?*Protosciurus douglassi* and ?*P. jeffersoni* represent a lineage of sciurids distinct from *Protosciurus* (*sensu* Black, 1963). Black (1963: fig. 7) derives the three Arikareean species of *Protosciurus* from the Orellan species, *P. mengi*. A ?*P. jeffersoni*–?*P. douglassi* lineage would originate in the Chadronian and end in the Orellan. Any common ancestor with *Protosciurus* would probably be in the late Eocene, though the earliest known species is Orellan.

A skull of ?*Protosciurus* cf. ?*P. jeffersoni* from the Chadronian of Wyoming (Emry, 1973) is currently being studied by Emry and Thorington of the National Museum of Natural History. This skull differs markedly from that of *Protosciurus* (Black, 1963), thus making ?*P. jeffersoni* and, in turn, ?*P. douglassi*, referable to a new genus (Black, personal communication)

Family Cricetidae Rocheburne, 1883

Eumys brachyodus Wood, 1937

(Fig. 2)

Referred specimen.—UNSM 66028, partial skull with complete dentition.

Horizon and locality.—Eckart Ranch locality, adjacent corners of secs. 17, 18, 19, 20, T19N, R48W, Whitney Member, Brule Formation, Morrill County, Nebraska.

Age.—Whitneyan (late middle Oligocene).

Description.—UNSM 66028 is a partial skull complete on the ventral side from the posterior margin of the palatine bones, and dorsally from the center of the orbits. The skull is nearly identical to that of *Eumys elegans* (see Wood, 1937) but is higher, with a broader snout and palate.

On the right side of the palate (Fig. 2) there are two molars. The anterior molar (?M^1) resembles M^1 of *Eumys brachyodus* (Martin, 1980). The posterior molar (?M^2) generally resembles M^2 of *E. brachyodus* but the posterior half of ?M^2 is narrower (bucco-lingually) than the anterior half. The hypocone and posterior cingulum are reduced, but not to the extent of an M^3 of *E. brachyodus*.

Anterior to ?M^1 is a deep pit. The anterior root of ?M^1 enters into the posterior end of this pit. The anterior wall of the pit is flattened and nearly vertical. There are no remnants of roots or any other indication that a tooth has occupied this pit.

Posterior to ?M^2 there is no indication of another tooth. The teeth of UNSM 66028 are heavily worn indicating that this specimen represents an old individual, thus making it impossible for an unerupted third molar to be present.

?M^1 and ?M^2 on the left side of the palate resemble those on the right. The left ?M^1 has a slightly more reduced anterocone than the right ?M^1, and the left ?M^2 is just slightly narrower posteriorly than the right ?M^2. Anterior to the left ?M^1 is a small tooth (?M^{ant}) that is triangular in outline. The only distinguishable cusp on ?M^{ant} is the ?hypocone, which is large and situated in the posterolingual corner of the tooth. Three lophs eminate from this cusp. One loph runs in a buccal direction along the posterior

margin of the tooth. A second runs anteriorly, perpendicular to the first, along the lingual margin of the tooth. The third loph runs obliquely from the ?hypocone in an anterobuccal direction. Valleys separate these three lophs. A small valley lies on the posterior side of the tooth at its center, putting a slight bend in the posterior loph. A similar valley lies in the center of the lingual margin of the tooth. This lingual valley resembles, somewhat, the internal valley between the protocone and hypocone on ?M^1 and ?M^2 but is much reduced.

Discussion.—Numerous authors have discussed the reduction in the number of cheek teeth in muroid rodents (see Wilson, 1956). Most of the discussion has been centered around whether the anterior cheek teeth have been lost, leaving M^1–M^3 only, or whether the posterior teeth have been lost, leaving P^4–M^2 or dP^4–M^2.

Wilson (1956) argued strongly that reduction of the posterior teeth was highly unlikely. He stated that instances of posterior supernumerary teeth in Recent muroids was not an indication of general posterior reduction because such cases should be much more common in the early history of the family (Oligocene) but were not, and that the most likely Eocene forms ancestral to the muroids (the sciuravids) had reduced the premolars, not the posterior molars.

If the anterior molars have been reduced in UNSM 66028 leaving only the small anterior tooth on one side, it must also mean that M^2 has developed an expanded anterocone as was present on M^1, and M^3 has been enlarged posteriorly to more closely resemble an M^2. In such a case, ?M^{ant} of UNSM 66028 would be homologous to M^1, ?M^1 would be homologous to M^2, and ?M^2 would be homologous to M^3.

If UNSM 66028 is an example of the loss of the posterior molars, it would involve the loss of M^3, modification of M^2, and then introduction of a supernumerary tooth anterior to M^1. In this case, ?M^{ant} would represent a supernumerary tooth, ?M^1 would be homologous to M^1, and ?M^2 would equal M^2.

Anterior reduction would also involve an anterior movement of the tooth row. The palatine foramina of *Eumys* are always situated medial to M^2 (see Wood, 1937; Martin, 1980). In UNSM 66028, these foramina are medial to ?M^2. If ?M^2 is homologous to M^3, as would be suggested by anterior reduction, its position on the palate has been moved considerably anterior.

Conversely, posterior reduction in the tooth row would indicate a posterior movement of the tooth row, based on its relation to the skull. In *Eumys,* the palatine-maxillary suture extends anterior to the level of M^2, and the tooth row terminates anteriorly just posterior to the posterior margin of the incisive foramina. If ?M^1 is homologous to M^1 in other specimens of *Eumys,* then the teeth have moved posteriorly so that the palatine-maxillary suture now extends anteriorly to the level of M^1, and the anterior extent of the tooth row (not including ?M^{ant}) has also moved considerably posterior.

UNSM 66028 is clearly an anomalous specimen. Because the true homologies of the teeth of UNSM 66028 are uncertain, this specimen cannot be used as an example to support either theory of posterior or anterior reduction in the tooth row in muroid rodents.

Two lower jaws of *Eumys brachyodus* have been recovered from the same locality as UNSM 66028 (CM 38701, CM 38704). Neither of these specimens show a marked reduction in M_1 or M_3.

Scottimus Wood, 1937

Eumys Leidy, Wood, 1937 (in part).
Paracricetodon Schaub, Alker, 1968 (in part).
Eoeumys Martin, 1980 (in part).

Type species.—*Scottimus lophatus* Wood, 1937.

Referred species.—*S. exiguus* (Wood, 1937); *S. kellamorum* Black, 1961; *S. viduus,* new species; *S. ambiguus,* new species; *S. longiquus,* new species; *Scottimus* sp.

Emended diagnosis.—Small cricetids with low skull; slender, parallel-sided snout; incisive foramina large extending posterior to anterior margin of M^1; infraorbital foramina and palatine foramina relatively large; two parasagital crests on skull; mandible slender; upper molars decrease in size posteriorly and develop longitudinal lophs buccally between the paracone and metacone and lingually between the lingual ends of the protocone and hypocone; protoloph on M^2–M^3 joins anterior arm of the protocone or anterior cingulum; anterior cingulum on M^2–M^3 extends to the buccal and lingual margins of the tooth; transverse lophs on the lower molars tend to be oriented more anteroposteriorly; M_1–M_2 with buccal posterior cingulum; I_1^1 with minute posteriorly radiating ridges on the anterior enamel surface of primitive species and I_1 smooth on advanced species.

Range.—Chadronian (early Oligocene) of Wyoming, Orellan (early middle Oligocene) of Montana, Nebraska, South Dakota, Colorado, Whitneyan (late middle Oligocene) of Nebraska and South Dakota, and Arikareean (late Oligocene) of Wyoming and South Dakota.

Discussion.—Wood (1937) first described *Scottimus* based on a single species, *S. lophatus,* from the Whitneyan of Nebraska. He recognized *Eumys exiguus* from the Orellan of South Dakota as the probable ancestor of *Scottimus.* Galbreath (1953) referred several specimens from the Orellan of northeastern Colorado to *Eumys* near *E. exiguus* and suggested that *Leidymys vetus* Wood (1937), also from Colorado, was synonymous with *E. exiguus.* Black (1961) named a new species of *Scottimus, S. kellamorum,* from the Arikareean of Wyoming and formally synonymized *L. vetus* with *E. exiguus,* including the Colorado specimens, and transferred the species to *Scottimus.*

Alker (1968) identified over 90 specimens from Nebraska as *E. exiguus,* which he transferred to the European genus *Paracricetodon.* Dawson and Black (1970) refuted Alker and suggested that the Nebraska specimens did not represent *S. exiguus,* and were probably referable to a small species of *Eumys.*

Wood (1980) included in *Scottimus exiguus* the Colorado specimens of *Eumys* near *E. exiguus* (Galbreath, 1953) and specimens described by White (1954) as *Eumys* cf. *exiguus* from the Orellan of Montana. Wood (1980) referred the Nebraska specimens (Alker, 1968) to *Eumys* cf. *parvidens,* maintained that *Leidymys vetus* was distinct from *S. exiguus,* and retained the former in its original generic allocation.

Martin (1980) recently erected a new genus, *Eoeumys.* He recognized two species, *Eo. vetus* (including the specimens referred by Galbreath, 1953, to *Eumys* near *E. exiguus* from Colorado) and *Eo. exiguus* (including the specimens referred by Alker, 1968, to *Paracricetodon* from Nebraska). The genus *Eoeumys,* based on the type specimen of *Leidymys vetus* (AMNH 8742), is distinct from both *Scottimus* and *Leidymys,* however, none of the specimens referred to *Eumys* (or *Scottimus*) *exiguus* (Wood, 1937; Galbreath, 1953; White, 1954; Alker, 1968) can be referred to this genus.

Eoeumys vetus (restricted to the holotype) differs in morphology of the skull from *Scottimus* (described below) in 1) having a shorter snout which tapers anteriorly; 2) incisive foramina small and placed more anterior; 3) palatine foramina small; 4) infraorbital foramina smaller and restricted more dorsally on the snout; and 5) the frontal-maxillary suture on the medial wall of the orbit forms a diagonal line running from the posteroventral corner to the anterodorsal corner. The only feature of the skull of *Eo. vetus* similar to that of *Scottimus* is the possession of parasagital crests (Fig. 3f). *Eoeumys* most closely resembles *Eumys* in the above listed features except in the possession of parasagital crests, a feature shared by both *Leidymys* and *Scottimus.*

Dentally, *Eoeumys vetus* (Fig. 4) differs from *Scottimus* in 1) lack of buccal or lingual lophs on the upper molars; 2) anterior cingulum on M^2–M^3 does not extend lingually; 3) protoloph of M^2–M^3 joins posterior arm of the protocone (on M^3 the protoloph is doubled and the anterior lophule joins the anterior arm of the protocone, a feature that commonly occurs in *Eumys elegans* and is present in the holotype of *E. parvidens*); and the enamel surface of the upper incisors is smooth. The teeth of *Eoeumys* do not differ from those of *Eumys* or *Coloradoeumys* Martin (1980).

In overall cranial and dental morphology, *Eoeumys* most closely resembles *Eumys,* but differs from the latter in possessing parasagital crests, slightly narrower snout, and infraorbital foramen not as ven-

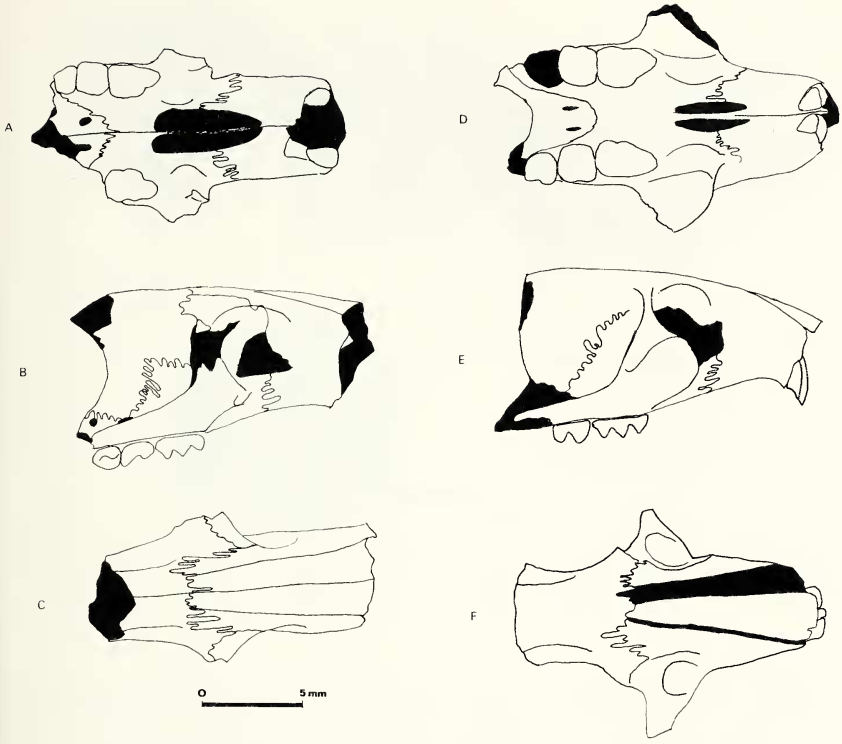

Fig. 3.—The skulls of *Scottimus* and *Eoeumys*. A–C, ventral, lateral, and dorsal view of the skull of *Scottimus viduus* (holotype) CM 10821; D–F, ventral, lateral, and dorsal view of the skull of *Eoeumys vetus* (holotype) AMNH 8742.

trally restricted. Wood (1937) noted these features as similar to the Arikareean *Leidymys*. He stated that *L. vetus* was morphologically intermediate between *Leidymys* and *Eumys* and could be referred to either genus. The relative proportions of the snout and restriction of the infraorbital foramen of "*Leidymys*" *vetus*, however, more closely resemble those of *Eumys* than those of *Leidymys* or *Scottimus*.

Martin (1980:17) mentioned a small cricetid skull from the Chadronian of Wyoming that was being described elsewhere. This specimen, according to Martin's description, is referable to *Scottimus*, and may represent the Chadronian species of *Scottimus* described below.

The uniqueness of the holotype of "*Leidymys*" *vetus* makes its retention in *Eoeumys* the most convenient allocation until more material is available.

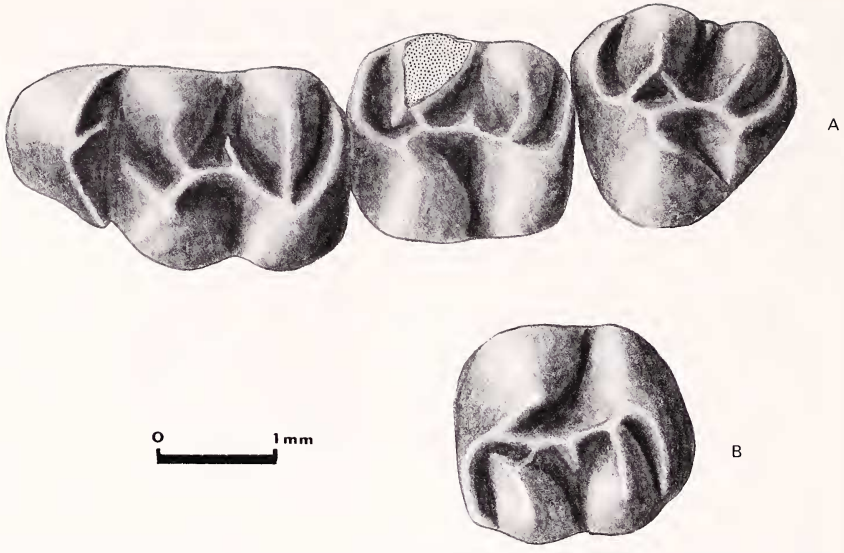

Fig. 4.—Upper teeth of *Eoeumys vetus,* holotype, AMNH 8742. A, LM^1–M^3; B, RM^2. Stippled area represents damaged area.

Alker's (1968) allocation of "*Eumys*" *exiguus* to *Paracricetodon* was based mainly on the minute multiple non-parallel ridges on the lower incisor. This type of ornamentation of the lower incisor is reported not only for the latter genus but also in species of *Eucricetodon* and *Pseudocricetodon* (Lindsay, 1978), restricting its use as the sole diagnostic feature of the genus.

Martin (1980), in separating "*Eoeumys*" (including specimens referred here to *S. ambiguus,* new species, *S. viduus,* new species, and *S. exiguus*) from *Scottimus,* cited only two differences between them—position of the anterocone on M^1 and presence of ridges on the lower incisor. He stated that the anterocone of *Scottimus lophatus* was centrally positioned and that of *Eoeumys* was buccal. The position of the anterocone on M^1 of *S. lophatus* is indeed more nearly central than that of *S. exiguus,* and the other primitive species of *Scottimus.* However, the anterocone of M^1 of *S. kellamorum* (Black, 1961: fig. 1) and "*Eumys* cf. *exiguus*" (White, 1954) is clearly intermediate. Also, the anterocone of *S. lophatus* may not be as buccal as it appears because the only published specimens with M^1 (Wood, 1937; Martin, 1980) are heavily worn, making the cusp look broader and more lingual. The minor difference in the placement of the anterocone of *S. laphatus* is more likely a specific difference than a generic one.

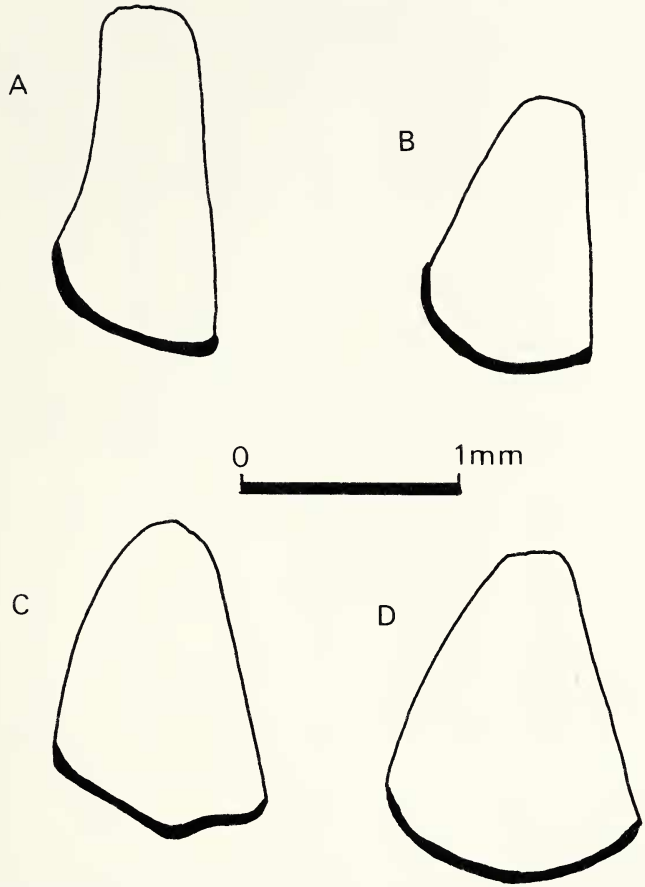

Fig. 5.—Cross-sectional shape of RI_1 of *Scottimus*. A, *S. viduus*, UNSM 65937; B, *S. ambiguus*, KU 8426; C, *S. longiquus*, USNM 18867; D, *S. lophatus*, UNSM 66167.

As is the case with the position of the anterocone, intermediate stages between ridged and smooth incisors exist within the species of *Scottimus*. Lower incisors are known for only four species of *Scottimus*—*S. viduus* new species; *S. ambiguus*, new species; *S. longiquus*, new species; *S. lophatus*. In the most primitive species (*S. viduus* and *S. ambiguus*) the fine "pinnate" ridges on I_1 are distinct. The lower incisor is laterally compressed in these species. In *S. lophatus*, I_1 is broad with a smooth enamel surface. However, in "*Eumys* cf. *exiguus*" (White, 1954; here referred to *Scottimus longiquus*, new species) from Montana, the lower incisor is broad, but not as much so

Table 2.—*Measurements of the teeth of a sample of* Scottimus viduus. *Measurements in millimeters. (Also see Tables 3 and 4.)*

Teeth	Measurement	N	OR	SD	CV	M	Holotype L	Holotype R
M^1	A-P	6	2.31–2.47	.08	3.3	2.39	2.31	2.32
	tra	6	1.40–1.56	.05	3.7	1.48	1.40	1.45
	trp	6	1.47–1.59	.04	3.0	1.53	1.47	1.50
M^2	A-P	5	1.51–1.76	.10	6.1	1.60		1.51
	tra	5	1.45–1.65	.08	5.2	1.52		1.49
	trp	5	1.35–1.55	.09	5.3	1.45		1.46
M^3	A-P	4	1.08–1.28	.09	7.7	1.19		1.08
	tra	4	1.19–1.39	.10	8.1	1.30		1.19
M^1–M^3		3	4.98–5.27					4.98
M_1	A-P	19	1.92–2.24	.09	4.3	2.09		
	tra	20	0.97–1.23	.07	6.1	1.09		
	trp	20	1.18–1.45	.08	5.7	1.31		
M_2	A-P	21	1.62–1.88	.07	4.1	1.76		
	tra	20	1.32–1.60	.07	5.0	1.45		
	trp	21	1.36–1.61	.07	5.0	1.45		
M_3	A-P	18	1.47–1.88	.12	7.1	1.68		
	tra	18	1.29–1.55	.07	5.2	1.40		
	trp	18	0.92–1.18	.09	8.3	1.04		
M_1–M_3		16	5.20–5.96	.22	4.0	5.58		
I_1	A-P	14	1.25–1.66	.11	7.9	1.40		
	tra	14	0.77–1.02	.08	9.3	0.88		

as in *S. lophatus*. Minute ridges, similar to those on I_1 of the primitive species of *Scottimus*, are much reduced in size and extent on the incisor of "*Eumys* cf. *exiguus*." These ridges are confined to a narrow "keel" on I_1 of the latter species. It is evident that intermediate forms do exist between the most primitive and the most advanced forms (Fig. 5). Martin (1980) compared only the two extreme cases.

Scottimus is not the only genus to exhibit such a variety of ornamentation on the incisors. In *Leidymys*, the number of ridges is variable on the upper and lower incisors (Martin, 1980). Lindsay (1978) reported that some species of *Eucricetodon* have lower incisors with a few parallel ridges and others have multiple non-parallel ridges.

Scottimus viduus, new species
(Figs. 3a, b, c, 6, 7, Tables 2, 3, 4)

Paracricetodon exiguus (Wood) Alker, 1968.
Eumys sp. Engesser, 1979.
Eoeumys exiguus (Wood) Martin, 1980 (in part).
Eumys cf. *parvidens* Wood, 1980.

Holotype.—CM 10821, partial skull with RM^1–M^2 and LM^1–M^2.

Hypodigm.—Holotype and CM 9711, CM 38654, CM 38655, PU 23265, KU 537, KU 539, KU 540, KU 8410–8418, and UNSM 10306, 10369, 65616–65631, 65910, 65912, 65914–65916, 65927–65950, 66009, 66010, 66031, 66035, 66038, 66039, 66044–66051, 66053–66065, 66156, 66169, 66182–66192, 66197, 66198. All specimens except the holotype are whole or partial mandibles or maxillae and isolated teeth.

Horizon and locality.—Holotype and CM 9711 from Warbonnet Creek locality, N½, T33N, R56W and NW¼ T33N, R55W, Orella Member, Brule Formation, Sioux County, Nebraska. UNSM and KU specimens are from various localities in the Orella Member of the Brule Formation, Sioux County, Nebraska (precise locality data for each specimen available on file at UNSM). CM 38654 and 38655 are from Pilgrim Creek locality (formation unknown), Jackson County, Wyoming. PU 23265 is from "Head of Battle Draw" (?)SW¼ T42N, R45W, Poleslide Member, Brule Formation, Shannon County, South Dakota.

Age.—Chadronian (Pilgrim Creek), Orellan (Sioux County), and possibly Whitneyan ("Head of Battle Draw").

Etymology.—*viduus*, Latin, lacking; intended to imply the lack of many of the advanced features of the other species of the genus.

Diagnosis.—Slightly smaller than *S. exiguus*; metaloph wider than protoloph on M^1; anterocone on M^1 large, lingually placed with posterobuccal reentrant valley of the anterocone open posteriorly; buccal longitudinal lophs on upper molars very weak and variably absent; mesolophs long on M^1–M^2; metaloph joins hypocone on M^1–M^2; mesolophids long on M_1–M_2; buccal posterior cingulum on M_1–M_2 minute; hypolophid joins ectolophid posterior to the mesoconid.

Description.—The skull of *S. viduus* closely resembles that of *Leidymys* (Fig. 3). It is relatively low with a long, narrow snout. The rostrum is parallel sided and flairs anteriorly. Two low parasagital crests run along the lateral margin of the frontal bones. The nasal bones widen anteriorly and terminate posteriorly just behind the anterior margin of the orbit, on the same line as the posterior extent of the premaxillary bones.

The frontal-maxillary suture on the medial wall of the orbit (Fig. 3b) is highly crenulate. Originating above M^2, this suture runs directly dorsal midway to the top of the skull, then runs directly anterior to the infraorbital foramen. The infraorbital foramen is large. The scar for the medial masseter extends relatively far onto the rostrum, farther than that of *Eumys* or *Eoeumys vetus* (Fig. 3e).

The incisive foramina also resemble those of *Leidymys*. They are large and posteriorly placed behind the anterior margin of M^1 (Fig. 3a). The palatine foramina are large, as described for *S. exiguus* (Wood, 1937), and medial to M^2. On the medial orbital wall there are two foramina. The sphenopalatine foramen is situated above M^2 at the junction of the frontal, maxillary and palatine bones. The dorsal palatine foramen is in the center of the portion of the palatine preserved, above M^3.

On M^1, the metaloph is wider than the protoloph, in contrast to other species of *Scottimus*. The metaloph clearly joins the center of the hypocone even on worn specimens (Figs. 6, 7a, b). A buccal loph running between the paracone and metacone,

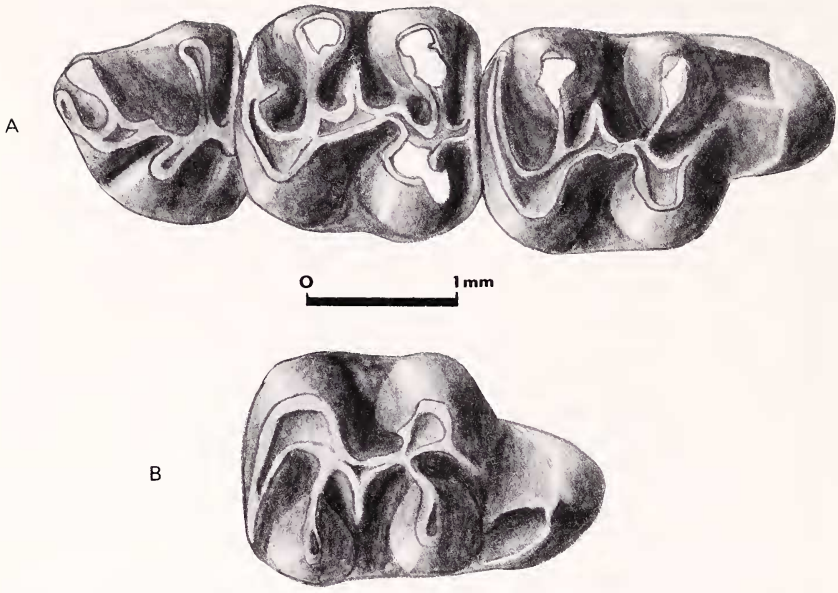

Fig. 6.—Upper teeth of *Scottimus viduus,* holotype, CM 10821. A, RM^1–M^3; B, LM^1.

present on other species, is variably present and even absent on some specimens. The anterocone is large and restricted to the buccal side of the tooth. The posterobuccal reentrant valley on the anterocone is widely open posteriorly.

M^2 is relatively broader than in *S. lophatus*. As on M^1 the metaloph runs directly to the center of the hypocone. The mesoloph is relatively long. As in all species of *Scottimus,* the anterior cingulum runs the entire width of the tooth and the protoloph joins the anterior arm of the protocone. The buccal longitudinal loph is very weak. On some specimens it appears to be nearly absent, as in M^1. The lingual margin of the protocone and hypocone have minor ridges running posteriorly and anteriorly, respectively.

The buccal longitudinal loph on M^3 is more distinct than on M^1–M^2. The anterior cingulum and protoloph are as in M^2. There is no mesoloph on M^3 and the metacone and hypocone are greatly reduced.

The lower molars are very similar to those of *Eumys* (Fig. 7c). The mesolophid on M_1–M_2 is long, approximately equal in length to the posterior arm of the protoconid, which extends lingually to the level of the apex of the metaconid. On M_2 there is a minute buccal posterior cingulum which is generally eliminated with moderate wear. This same structure is only present on unworn specimens of M_1.

The hypolophid on M_1–M_2 joins the ectolophid posterior to a distinct mesoconid. A buccal spur from the mesoconid is variably present on all molars. The posterior arm of the protoconid reaches the lingual margin of the tooth in M_3 on about half of the specimens.

The fine "pinnate" ridges on I_1 are distinct and restricted to the enamel surface. The upper incisors of the type specimen have minute ridges running obliquely across the anteromedial corner of the enamel surface.

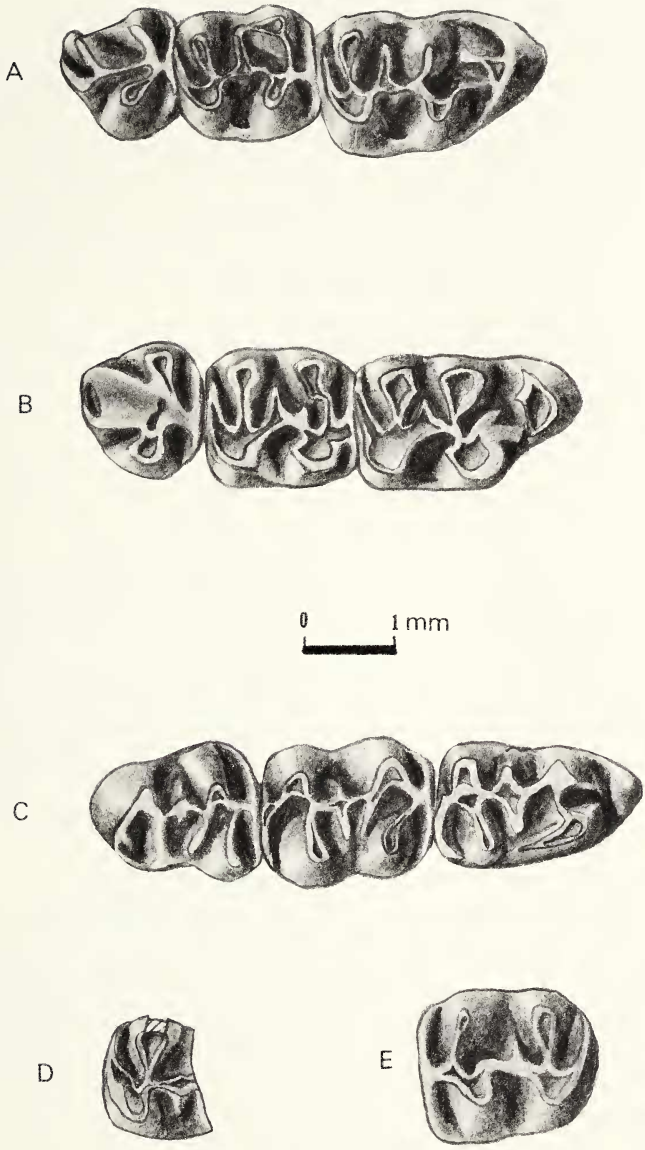

Fig. 7.—Dentition of *Scottimus viduus*. A, UNSM 65910, RM^1–M^3; B, UNSM 65939, RM^1–M^3; C, UNSM 66054, LM_1–M_3; D, CM 38654, RM_1; E, CM 38655, LM^2.

Discussion.—*Scottimus viduus* is the most primitive species of the genus dentally. The longitudinal lophing of the molars in *S. viduus* is quite weak and nearly absent in some specimens. The lack of many of the advanced characters of *Scottimus* led Dawson and Black (1970) to suggest that the Nebraska specimens were referable to *Eumys*.

Two isolated teeth, a partial M_1 (CM 38654, Fig. 7d) and an M^2 (CM 38655, Fig. 7e) are from the Chadronian Pilgrim Creek fauna (see Sutton and Black, 1975, for locality and age data). The longitudinal lophs on the M^2 are not developed, but the attachment of the protoloph and the lingual extension of the anterior cingulum are the same as in the topotypic material from Sioux County, Nebraska. The M_1 is worn and any trace of a buccal posterior cingulum has been removed. This tooth is referred to this species on the basis of size. The only other species of cricetid from Pilgrim Creek is *Eumys elegans*, considerably larger than CM 38654.

The M^1 on PU 23265 from South Dakota is longer than any of the specimens from Nebraska (Tables 2, 3) but in all other measurements of M^1 and M^2 it is within the range of *S. viduus*. The morphology of the molars of PU 23265 makes it clearly referable to *S. viduus*.

The skull of *Scottimus viduus* is nearly identical to that of *Leidymys* except that the former may have a slightly more restricted infraorbital foramen. It is difficult, however, to determine the exact size of the infraorbital foramen in *Leidymys* because the only known skull preserving the infraorbital foramina (AMNH 7028) is badly damaged in the area of the foramina, which has artifically enlarged them (Wood, 1936). The infraorbital foramina do not appear to be as large as the figures by Martin (1980: figs. 15, 25a) indicate. The right infraorbital foramen is partially preserved on the type specimen of *L. nematodon* (AMNH 7018) and is much smaller than has been illustrated for *L. lockingtonianus*.

Alker (1968) reported that the youngest occurrence of *S. viduus* (=*Paracricetodon exiguus*) was from the early Whitneyan. Only one specimen from the Nebraska collection (UNSM 66051) is listed from the Whitney. However, according to the field number associated with this specimen, it was recovered from the lower Orella Member, Sioux County. Several other specimens with this same field number are all listed from the lower Orella. Martin (1980:17) cited a small cricetid skull from the Chadronian of Wyoming. It may be referable to *S. viduus* based on his brief description of the specimen.

Scottimus ambiguus, new species
(Fig. 8, Table 3, 4)

Eumys near *E. exiguus* Wood, Galbreath, 1953.
Scottimus exiguus (Wood) Black, 1961 (in part).
Eoeumys vetus (Wood) Martin, 1980 (in part).

Table 3.—*Measurements of upper teeth of* Scottimus. *Measurements in millimeters.*

	M^1			M^2			M^3			
Specimen no.	A-P	tra	trp	A-P	tra	trp	A-P	tra	trp	M^1–M^3
				Scottimus ambiguus						
KU 8419	2.19	1.24	1.28	1.58	1.40	1.32	1.04	1.19		4.91
KU 8420	2.19	1.31		1.56		1.39	1.34	1.30		5.17
				Scottimus viduus						
PU 23265	2.65	1.48	1.57	1.75	1.59	1.58				
CM 38655				1.67	1.58	1.49				
				Scottimus longiquus						
USNM 18865	2.78	1.86	1.80	1.97	1.74	1.64				
PU 23267a		1.80		2.04	1.73	1.57				
PU 23267b	2.87	1.78	1.68							
				Scottimus sp.						
PU 23264				1.90	1.53	1.44		1.38		

Holotype.—KU 8419, maxilla with LM^1–M^3.

Hypodigm.—Holotype and KU 8420, LM^1–M^3; KU 8421, 8422, LM_1–M_3; KU 8423, RM_1–M_2; KU 8424, LM_2; KU 8426, LM_1–M_3.

Horizon and locality.—Holotype and all referred specimens from the Cedar Creek Member, White River Formation, Logan County, Colorado. Type and KU 8420 from SW¼ sec. 12 and SE¼ sec. 3, T11N, R54W; KU 8421 and 8422 from E½ sec. 3, T11N, R54W; KU 8423 and 8424 from W½ sec. 7, T11N, R53W; and KU 8426 from SW¼ sec. 21, T11N, R53W.

Age.—Orellan (early middle Oligocene).

Diagnosis.—Near size of *S. viduus*; upper molars narrow; protoloph narrower than metaloph on M^1; anterocone on M^1 buccal; posterobuccal reentrant valley of the anterocone of M^1 open posteriorly; buccal lophs on M^1–M^3 weak but present; metaloph joins posterior margin of hypocone on M^1 in unworn specimens, and joins the posterior cingulum with wear; hypolophid joins ectolophid at mesoconid on m_1–M_2; mesolophid on M_1–M_2 minute to absent; buccal extension of mesoconid present on M_1–M_3.

Description.—On KU 8419 (Fig. 8a), the posterior margin of the incisive foramen is preserved. This foramen is similar to those of *S. viduus* and *S. exiguus*. The upper molars most closely resemble those of *S. exiguus*. The upper molars are much narrower (buccolingually) than in *S. viduus*, but fit within the observed ranges of size of M^2 of the latter in length. The anterocone on M^1 is large and buccally situated, as in *S. viduus*. The posterobuccal reentrant valley of the anterocone, again as in *S. viduus*, is open posteriorly. On the unworn specimen (KU 8419) the metaloph of M^1 is directed posteriorly, then bends anterior just buccal to the hypocone, joining it near its center (Fig.

Table 4.—*Measurements of lower teeth of* Scottimus. *Measurements in millimeters.*

	M_1			M_2			M_3				I_1	
Specimen no.	A-P	tra	trp	A-P	tra	trp	A-P	tra	trp	M_1–M_3	A-P	tra
						Scottimus ambiguus						
KU 8421	2.07	1.11	1.39	1.73	1.47	1.49	1.58	1.44	1.06	5.54	1.14	0.82
KU 8422	1.88	1.10	1.26	1.67	1.42	1.40	1.70	1.45	0.98	5.31	1.23	0.93
KU 8423	1.98	1.05	1.23	1.79	1.37	1.44					1.29	0.83
KU 8424				1.68	1.40	1.36						
KU 8426	1.95	1.08	1.27	1.73	1.43	1.47	1.68	1.43	1.12	5.41	1.15	0.75
						Scottimus viduus						
CM 38654			1.31									
						Scottimus longiquus						
USNM 18867	2.60	1.60	1.76	2.18	1.77	1.76	2.32	1.75	1.48	7.18	1.39	0.96
USNM 18866	2.42	1.51	1.60	2.06	1.62	1.50	2.01	1.55	1.14	6.49		

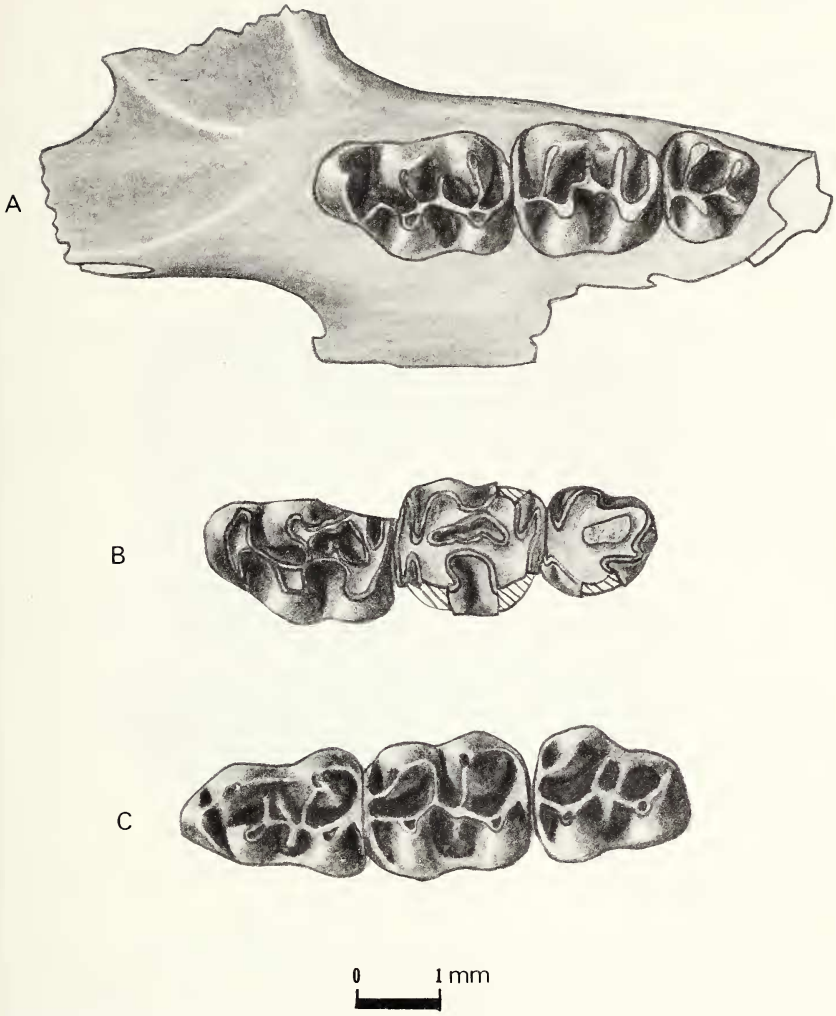

Fig. 8.—Dentition of *Scottimus ambiguus*. A, KU 8419 (holotype), LM^1–M^3; B, KU 8420, LM^1–M^3; C, KU 8421, LM_1–M_3.

8a). On KU 8420, the worn specimen (Fig. 8b), the metaloph of M^1 joins the posterior cingulum.

M^2 of *S. ambiguus* is nearly identical to that of *S. exiguus*, except that the metaloph joins the hypocone directly. In the type specimen of *S. exiguus* (AMNH 12261, Fig. 9b) the metaloph of the left M^2 clearly joins the posterior cingulum. On the right M^2 the metaloph bends anteriorly, as in the M^1 of *S. ambiguus*, just buccal to the hypocone

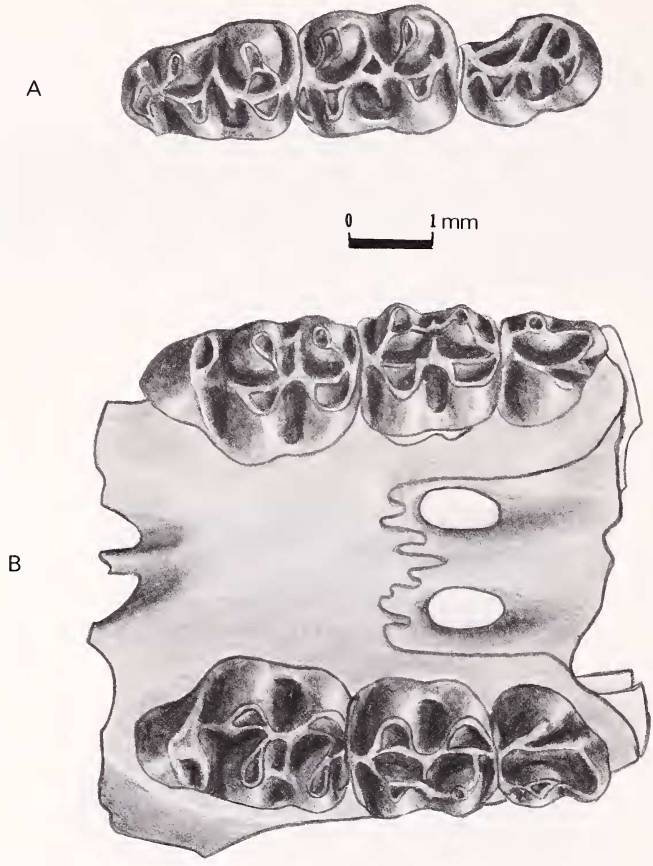

Fig. 9—Holotype of *Scottimus exiguus*, AMNH 12261. A, LM_1–M_3; B, palate with LM^1–M^3 and RM^1–M^3.

and joins it posterior to its center. It appears that after some wear, however, the metaloph on the right M^2 will merge with the posterior cingulum, as it does on the M^1 of *S. ambiguus*.

M^3 does not differ in morphology from those of other species except for the weaker development of the longitudinal lophs and smaller size relative to M^1 and M^2.

The lower molars of *S. ambiguus* more closely resemble those of *S. exiguus* than *S. viduus* (Fig. 8c) in having small but distinct buccal posterior cingulua on M_1–M_2, the hypolophid joining the mesoconid, posterior arm of the protoconid always extending to the lingual margin of the tooth on M_3, and having a buccal extension from the mesoconid on M_1–M_3.

The mesolophid on M_1–M_2 is minute to absent in *S. ambiguus*. In *S. exiguus*, the mesolophid is short and unites with the posterior arm of the protoconid (Fig. 9a).

On one specimen of *S. ambiguus*, KU 8426, the hypolophid on M_1 joins the ectolophid just posterior to the mesoconid as in *S. viduus*. All other specimens of *S. ambiguus* have the hypolophid joining the mesoconid on M_1.

I_1 of *S. ambiguus* is shorter (A-P) than that of *S. viduus* (Figs. 5a, b), and the minute radiating ridges are less distinct.

Discussion.—*Scottimus ambiguus* most closely resembles *S. exiguus* in dental morphology. The connection of the metaloph on M^2 and the position of the posterobuccal reentrant valley in the anterocone of M^1 in *S. ambiguus* are more similar to the condition in *S. viduus*. The degree of lophodonty in *S. ambiguus* is also somewhat less than that of *S. exiguus*, but slightly more than that of *S. viduus*. Martin (1980) referred the specimens assigned here to *S. ambiguus* to *Eoeumys vetus* based on size. *Eo. vetus*, however, is clearly larger than any specimens of *S. ambiguus* (Tables 3, 4; Wood, 1937:258).

Setoguchi (1978) referred an isolated M^1 (CM 32939) to *Eumys parvidens* from the Orellan Cedar Ridge fauna of Wyoming (see Korth, 1980, 1981, for age determination). This specimen is identical in morphology to *Scottimus ambiguus* but is slightly larger in size (Setoguchi, 1978: table 11). CM 32939 is here referred to *Scottimus* cf. *S. ambiguus*.

Scottimus longiquus, new species
(Fig. 10, Tables 3, 4)

Eumys exiguus Wood, 1937 (in part).
Eumys cf. *exiguus* Wood, White, 1954.
Scottimus exiguus (Wood) Wood, 1980 (in part).

Holotype.—USNM 18865, partial maxilla with LM^1–M^2.

Hypodigm.—Type and USNM 18866, partial mandible with RM_1–M_3; USNM 18867, mandible with RM_1–M_3; PU 23267a, maxilla with LM^1–M^2; PU 23267b (listed as PU 11385 by Wood, 1937:254), RM^1.

Horizon and locality.—Type and USNM specimens from the Canyon Ferry Reservoir area, locality 24LC17, "Toston beds" (Douglass, 1901), Lewis and Clark County, Montana. PU specimens from "Head of Battle Draw" (?)SW¼, T42N, R45W, Poleslide Member, Brule Formation, Shannon County, South Dakota.

Age.—Orellan (Montana) and possibly Whitneyan (South Dakota).

Etymology.—*longiquus*, Latin, long; in reference to the higher, longer lophs on the molars.

Diagnosis.—Large size, just slightly smaller than *S. lophatus*; molars highly lophate; M^1 with protoloph wider than metaloph, and anterocone predominantly buccally situated; posterobuccal reentrant valley on anterocone of M^1 opens bucally with a restricted opening; metaloph joins posterior cingulum on M^1–M^2; mesoconid and mesolophid minute or absent on M_1–M_3; posterior arm of protoconid short on lower molars and does not extend to the lingual margin of the tooth on M_3; minute ridges on I_1 reduced and restricted to a low central keel along the center of the anterior surface of the tooth.

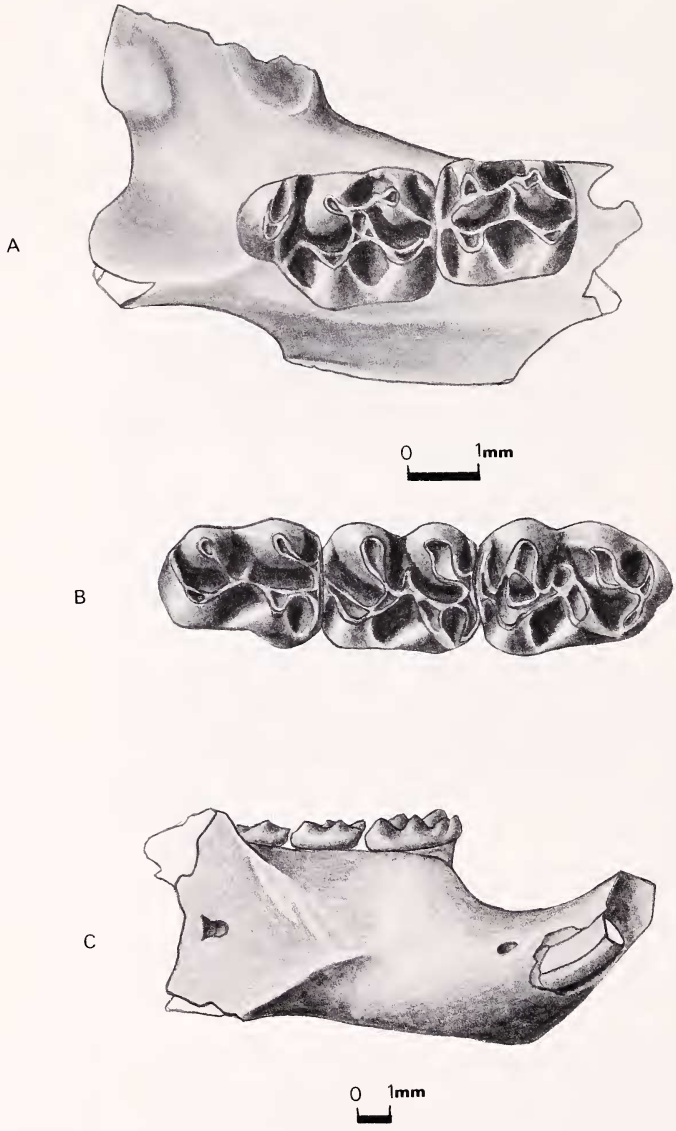

Fig. 10.—Dentition of *Scottimus longiquus*. A, USNM 18865 (holotype), LM^1–M^2; B, USNM 18867, LM_1–M_3; C, USNM 18867, lateral view of mandible.

Description.—The posterior margin of the incisive foramen is farther posterior than in other species of *Scottimus,* nearly to the level of the protocone of M^1 (Fig. 10a). The upper molars are highly lophate with well developed buccal and lingual longitudinal lophs. M^1 differs from that of *S. lophatus* only in having an anterocone less anteroposteriorly compressed and more restricted to the buccal half of the tooth. The posterobuccal reentrant valley of the anterocone is oriented buccolingually, and opens buccally through a restricted opening.

M^2 differs from that of *S. lophatus* only in the length of the mesoloph which extends bucally to the buccal longitudinal loph, and in being relatively broader (buccolingually). On both M^1 and M^2, the metaloph joins the posterior cingulum far behind the hypocone.

The lower molars of *S. longiquus* strongly resemble those of *S. lophatus* (Fig. 10b). The mesoconid and mesolophid are absent on all of the lower molars. The posterior protoconid arm on M_1–M_2 is greatly reduced. The posterior protoconid arm on M_3 fails to reach the lingual margin of the tooth, unlike that in *S. lophatus.*

The ectolophid is nearly in the center of the lower molars of *S. longiquus* as in *S. lophatus.* The lower molars of *S. longiquus,* as in the upper molars, are broader than those of *S. lophatus.* The buccal posterior cingulum on M_1–M_2 of *S. longiquus* is short, comparable to that of *S. exiguus.* An accessory loph is present on the talonid of M_1 on USNM 18867 (Fig. 10b). It runs lingually from the hypoconid toward the entoconid, bisecting the valley bounded by the posterior cingulum and hypolophid.

The lower incisor of *S. longiquus* differs from that of *S. viduus* and *S. ambiguus* in being much wider (tra) and having a low central keel that runs the entire length of the tooth. The minute radiating ridges present on I_1 of *S. viduus* and *S. ambiguus* are weakly developed on *S. longiquus,* and restricted to the surface of the central keel.

Discussion.—The development of lophs on the molars of *S. longiquus* exceeds that of the Arikareean species *S. kellarmorum* (Black, 1961). *S. longiquus* is distinguished from *S. lophatus* in the morphology of the anterocone on M^1, the length of the mesoloph on M^2, relative width of the molars, smaller size, cross-sectional shape of I_1, and shorter buccal posterior cingulum on M_1.

S. longiquus differs from the other Orellan species previously described in its larger size and greater development of lophs on the molars.

Scottimus sp.
(Fig. 11, Table 3)

Scottimus lophatus Wood, 1937 (in part).

Referred specimen.—PU 23264 (listed as PU 11385 by Wood, 1937:256 and Macdonald, 1963:200), partial maxilla with LM^2–M^3.

Horizon and locality.—"Head of Battle Draw," (?)SW¼, T42N, R45W, Poleslide Member, Brule Formation, Shannon County, South Dakota.

Age.—Late Orellan or early Whitneyan.

Description.—M^2 of PU 23264 more nearly approaches that of *S. lophatus* in morphology than of any other species. M^2 is narrower in relation to length than all other Orellan species, and comparable in proportions to *S. lophatus* and *S. kellamorum.* The degree of lophodonty of M^2–M^3 of *Scottimus* sp. equals that of *S. lophatus.* The only

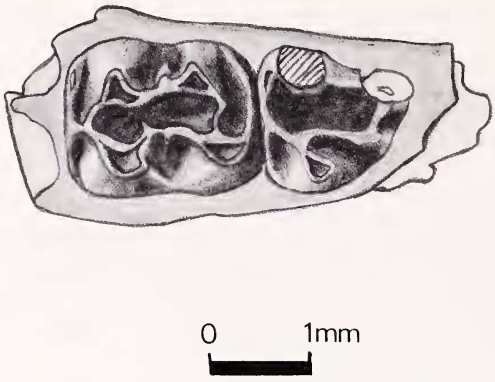

Fig. 11.—*Scottimus* sp., PU 23264, LM^2–M^3.

difference in morphology of M^2 of *Scottimus* sp. from *S. lophatus* is the connection of the metaloph to the hypocone in PU 23264 (Fig. 11). *S. kellamorum* has a similar connection, but it is much less distinct and does not have the obvious bend seen in PU 23264. The bend in the metaloph of M^2 of PU 23264 is similar to that in the right M^2 in the holotype of *S. exiguus* (Fig. 9b) and M^1 of the holotype of *S. ambiguus* (Fig. 8a). In all of these cases it appears that the metaloph will join the posterior cingulum after the tooth is moderately worn.

M^3 of PU 23264 is quite similar to that of *S. lophatus* in the height and arrangement of the lophs.

Scottimus sp. is smaller than *S. lophatus*.

Discussion.—Wood (1937:256) listed a specimen of *Scottimus lophatus* from South Dakota in his tables (listed as PU 11385), but suggested that this specimen might represent a distinct species which was intermediate between *S. lophatus* and its probable ancestor "*Eumys*" *exiguus*. PU 23264 clearly differs from *S. exiguus* in size, relative width of the upper molars, absence of a mesoloph on M^2, and degree of lophodonty. It more closely resembles *S. lophatus* in all of these features, but differs from the latter in size and connection of the metaloph to the hypocone on M^2.

PU 23264, though distinct from all other species of *Scottimus,* is too poorly known to establish a new species. If *Scottimus* sp. is accepted as a distinct species, there are three species of *Scottimus* known from the "Head of Battle Draw," South Dakota. This is unusual because no more than one species of *Scottimus* is known from any other locality. The other two species present at "Head of Battle Draw," *S. longiquus* and *S. viduus,* are readily separable from PU 23264, and are otherwise only known from Orellan deposits in Montana and Nebraska (also Chadronian of Wyoming), respectively. All of the specimens from "Head of the Battle Draw" were collected in 1893 by J. B. Hatcher

for Princeton University. In his original field notes, Hatcher described this locality as "Upper *Oreodon* beds, White River, Miocene" (D. Baird, personal communication). In the Big Badlands area of South Dakota, however, there is no "Battle Draw," though there is a Battle Creek Draw. This appears to be the location Hatcher intended in his original field notes.

Both Wanless (1923) and Clark et al. (1967) have mapped this area. The head of Battle Creek Draw is just to the north of Cuny Table, SW¼, T42N, R45W, Shannon County. Wanless (1923: Pl. 1, fig. 1 and text fig. 5) provided a photograph and stratigraphic section of this area. He recognized two lithologic units in this area—the "Upper *Oreodon* beds" below, and the "*Leptauchenia* beds" above. Clark et al. (1967: fig. 52) also provided a measured section from the area near Battle Creek Draw. They recognized Wanless' "Upper *Oreodon*" and "*Leptauchenia*" beds in this area as being equivalent to the Poleslide Member of the Brule Formation which contains Orellan (lower) as well as Whitneyan (upper) faunas (see Harksen, 1969). It is not unlikely that Hatcher's collection was made over the entire area and Orellan and Whitneyan faunas were mixed. Therefore, the three species recognized from "Head of Battle Draw" cannot be definitely assigned to an Orellan or Whitneyan age in this area.

Macdonald (1963) reported two isolated M^2s from the Arikareean Sharps Formation of South Dakota, which he referred to *Scottimus* sp. These two specimens are near the size of *Scottimus* sp. described above, but are wider than PU 23264 (Macdonald, 1963: 200) and may not be assigned to the same species. The two Sharps specimens may well represent a distinct Arikareean species of *Scottimus* but more material is needed to determine their specific allocation.

Species of Scottimus

In all, seven species of *Scottimus* are recognized here. One species, *S. viduus,* appears in the Chadronian and persists into the Orellan. Hough and Alf (1956) reported specimens of "*Eumys*" *exiguus* from Chadronian ant hills in Nebraska. However, Guthrie and Allen (1974) have shown that these ant hills contained predominately Orellan species and that this occurrence of Orellan forms should not be considered as Chadronian.

During the Orellan, *Scottimus* attained its greatest diversity, as does *Eumys*. Besides *S. viduus* from Nebraska and South Dakota, four species of *Scottimus* are known from the Orellan—*S. ambiguus* from Colorado, *S. exiguus* from South Dakota, *S. longiquus* from Montana and South Dakota, and *Scottimus* sp. also from South Dakota. Any one, or all, of the species present at the "Head of Battle Draw" (*S. viduus, S. longiquus, Scottimus* sp.) may also be from the Whitneyan.

Wood (1937, 1980) cited *S. lophatus* from the Orellan of Nebraska. However, the only known specimens of *S. lophatus* from Nebraska (MCZ 5067, UNSM 66168, UNSM 66167—listed as UN 8-4-8-33-SP by Wood, 1937:255) are from the Whitney Member of the Brule Formation (Martin, 1980). *S. lophatus* is the only species of the genus definitely known from the Whitneyan.

Scottimus kellamorum and the two Sharps specimens (not referable to *S. kellamorum*) are the only Arikareean representatives of the genus.

Martin (1980) considered that *Eoeumys* represented the basal stock from which all later Oligocene and early Miocene cricetids were derived. The specimens of *Scottimus* that he included in *Eoeumys* were already too specialized to be considered as ancestors of later cricetids. However, *Eoeumys,* if restricted to the holotype, may represent the basal eumyine if Martin is correct in assuming the presence of parasagital crests as primitive for cricetids.

Cricetid genus and species indeterminate
(Fig. 12)

Referred specimen.—CM 2290, right mandible with I_1, M_2.

Horizon and locality.—?White River Formation, White Butte, Billings County, North Dakota.

Age.—Orellan (early middle Oligocene).

Description.—The mandible of CM 2290 is deep and heavy (Fig. 12b). The masseteric fossa is bounded by a heavy ridge originating from the posteroventral margin of the mandible, and a less well developed ridge originating from the anterior edge of the ascending ramus. These two ridges unite anteriorly below M_1. The diastema is shallow and relatively short. The mental foramen lies at mid-depth of the mandible below the center of the diastema. A broad, deep valley separates the tooth row from the ascending ramus.

The lower incisor is broad, rounded anteriorly, and asulcate, with enamel extending slightly onto the medial and lateral sides of the tooth.

From the alveolae present, the molars increase in size from M_1 to M_3. M_2 is lophate and rectangular in outline (Fig. 12a). The anterior cingulum extends nearly the entire width of the tooth, but is more pronounced buccally. It is joined at its center by the anterior arm of the protoconid and the metalophid. Posterior to the metaconid is a distinct mesostylid. It is an elongate convex cusp which bends toward the center of the tooth and blocks the anterior ¾ of the valley between the metaconid and entoconid. The posterior arm of the protoconid runs obliquely across the tooth to the entoconid. There is no sign of an ectolophid. On the posterior arm of the protoconid, midway to the entoconid, are two short "spurs" eminating from it. The shortest projects lingually into the valley between the metaconid and entoconid. The longer spur extends buccally into the valley between the protoconid and hypoconid, about halfway to the buccal margin of the tooth.

The posterior cingulum is broad and arises as the posterior arm of the hypoconid. A deep wide valley separates the posterior cingulum from the entoconid.

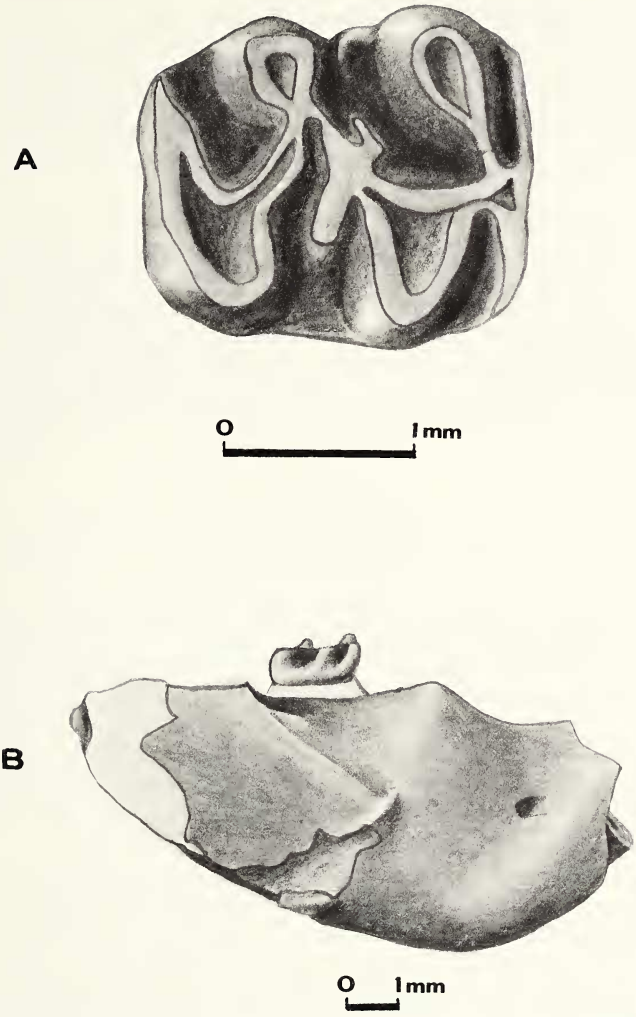

Fig. 12.—Cricetid genus indeterminate, CM 2290. A, occlusal view of RM_2; B, lateral view of mandible.

Discussion.—CM 2290 closely resembles *Eumys elegans* in size and morphology of the mandible and lower incisor. The only difference in the mandible of *Eumys* and CM 2290 is the breadth of the valley separating the tooth row from the ascending ramus. In CM 2290, this valley is no deeper than in *Eumys elegans*, but is much wider.

The most striking difference from *Eumys* in the occlusal pattern of M_2 of CM 2290 is the lack of an ectolophid and the posterior arm of the protoconid joining the entoconid. The posterior arm of the protoconid joins the entoconid in one species *Eumys, E. obliquidens* Wood (1937), later considered a variation of *E. elegans* (Galbreath, 1953). However, all specimens with this connection in *E. "obliquidens,"* maintain an ectolophid.

The valley between the posterior cingulum and entoconid of CM 2290 is wider than that in *Eumys*. The mesostylid in CM 2290 differs from that in *Eumys*. In large populations of *E. elegans,* several specimens may have mesostylids, but they are minute, round cuspules, unlike the mesostylid in CM 2290. The buccal spur on the posterior arm of the protoconid in CM 2290 also differs from that of *Eumys*. *E. elegans* has a strong mesoconid but there is no buccal extension of this cusp. A lingual spur is present but smaller on some specimens of *E. brachyodus*.

Any one of these differences between CM 2290 and *Eumys* could well be considered only a minor variation in a population. However, the combination of all of these differences makes this possibility very unlikely.

The ectolophid on M_2 of *Wilsoneumys planidens* runs obliquely across the tooth, in some cases, and joins the hypolophid buccal to the entoconid. On some specimens a minute lingual and buccal spur are present on the ectolophid (Wilson, 1949*a*; Galbreath, 1953; Setoguchi, 1978; Martin, 1980). This arrangement somewhat resembles that of CM 2290. However, CM 2290 is less lophate than *Wilsoneumys* and differs in a number of other features of M_2. No other North American Oligocene cricetid has the unique morphology of the posterior arm of the protoconid of M_2 of CM 2290.

Two late Oligocene genera from central Asia, *Aralomys* and *Eumysodon* Argyropulo (1939) share many similarities with CM 2290. In both Asian genera, the posterior arm of the protoconid joins the entoconid on M_2. In *Aralomys,* it is directly connected and in *Eumysodon* a short hypolophid joins the posterior arm of the protoconid just buccal to the entoconid.

The valley separating the entoconid and posterior cingulum is wider in CM 2290 than in either Asian genus. Some specimens of *Eumysodon* have a lingual spur on the posterior arm of the protoconid (Argyropulo, 1939: fig. 1). Neither *Aralomys* nor *Eumysodon* have a buccal spur on the posterior arm of the protoconid of M_2. The relative sizes of the molars in *Aralomys* and *Eumysodon* do not increase from M_1–M_3 as in CM 2290.

CM 2290 appears to represent a distinct cricetid. It is still possible, but unlikely, that it may represent a variation of *Eumys elegans*. Spec-

imens showing intermediate stages must be found in order to establish this. In overall appearance of the M_2, CM 2290 most closely resembles *Aralomys* and *Eumysodon* from Asia, but is clearly distinct from both.

Measurements of M_2 of CM 2290 are as follows: A-P, 2.04 mm; tra, 1.70 mm; trp, 1.58 mm. Measurements of I_1 are as follows: A-P, 1.83 mm; tra, 1.44 mm.

ACKNOWLEDGMENTS

I would like to thank Drs. M. R. Dawson of the Carnegie Museum of Natural History, Pittsburgh, M. R. Voorhies and T. M. Stout of the University of Nebraska State Museum, D. Baird of Princeton University, L. D. Martin of the University of Kansas, and R. Emry of the National Museum of Natural History for the gracious loan of specimens from their respective institutions. I would also like to thank Drs. Baird, P. Bjork, Martin, Voorhies, and C. C. Black for assistance with discussions and the location of specimens. The following people also assisted me in various ways, R. G. Corner, C. Swisher, and M. Jones. Dr. Dawson critically read parts of this manuscript. The figures were prepared by the author.

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